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ABSTRACT

As part of a project that identified the specific literacy skills required in ten occupations, this report provides two levels of instructional information about auto mechanics. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, teachers, and counselors. These sections note the specific literacy requirements (reading, writing, listening, speaking, and mathematics) that were identified at three job sites and in three vocational training programs. Part III presents instructional methods/materials that adult basic education teachers can use to develop literacy skills while imparting job related knowledge. The lesson format is based on a directed reading activity and includes vocabulary and concept development, sentence and organizational structure, silent reading, and skill development. Appendixes list the technical vocabulary that auto mechanics need to know, the 100 words that represent 45% of the language sampled for the entire project, and occupational literacy requirements for the ten occupations that were studied. (AEA)

THE LITERACY REQUIREMENTS OF AN AUTOMOTIVE MECHANIC ON THE JOB AND IN A VOCATIONAL TRAINING PROGRAM

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PROJECT ABSTRACT

THE IDENTIFICATION OF LITERACY REQUIREMENTS OF JOBS IN INDUSTRY AND CORRESPONDING VOCATIONAL TRAINING PROGRAMS

1.	Need Addressed:	Meeting the educational needs of adults with minimal literacy skills who wish to enter skilled or semi-skilled occupations.
2.	Population Served:	Adults with minimal literacy skills.
3.	Brief Description:	Specific literacy requirements (reading, writing, listening, speaking, and mathematics) of semi-skilled and skilled occupations in business, industry and vocational training programs were determined. The literacy demands of three work contexts and training programs for each of the ten occupations were analyzed and reported.
4.	Major Objectives:	To provide educators, counselors, and administrators with a description of the literacy requirements of semi-skilled and skilled occupations and training programs to which functionally illiterate adults aspire.
5.	Products:	A description of the literacy requirements necessary to hold a job in each of ten occupations and the corresponding requirements necessary to succeed in vocational training programs which prepare individuals for each of those occupations is provided. A booklet for each of the ten jobs was prepared.

INTRODUCTION

This project was undertaken in response to a need, expressed by adult basic educators and counselors, for information about the specific literacy skills necessary for success in several occupations. The occupations studied had been identified as desirable careers during informal interviews with adults who were enrolled in basic education programs in the Lafayette, Indiana area. Employment counselors and officials of the Office of Career Development confirmed that the occupations identified for study were appropriate. Because Greater Lafayette offers a wide range of occupational and training opportunities, the project staff was able to study both job sites and vocational training sites for each of the following occupations: account clerk, automotive mechanic, draftsman, electrician, heating and air conditioning mechanic, industrial maintenance mechanic, licensed practical nurse, machine tool operator, secretary, and welder.

Purpose and Audience

This report provides descriptive and instructional information to adult educators at two levels. Factual data are presented in Parts I and II for use in decision making by program developers, administrators, lead teachers, and counselors. Part III presents instructional methods and materials and is meant for use by adult basic education teachers. Members of both groups may be interested in the entire report, but in preparing it the project staff attempted to address the needs of the two audiences separately.

Procedures

To identify reading, writing, speaking, listening, mathematics, and other characteristics which are necessary for success both on the job and in the training program, three job sites and three vocational college courses were studied.

Required reading materials from each of the six settings were evaluated using two widely used readability formulas, the Dale-Chall Formula and the Fry Readability Graph. Readability estimates were computer assisted. A minimum 2000 word sample of written language was taken from each site. Special considerations and problems related to reading the technical materials were identified, and the relative use of reading as a work tool and as a learning tool was determined.

To identify speaking and listening requirements, one hour samples of oral language were recorded at each job site and in each vocational college course. Language recorded at each site was rated for its technical and formal qualities, and computer-analyzed to assess vocabulary and syntax. Written and oral language samples were used to develop the Key Technical Vocabulary List found in Appendix A. The combined language samples from all occupations studied were used to develop the Highest Frequency Word List found in Appendix B. A summary of the literacy requirements for all ten occupations studied is found in Appendix C.

Writing samples were obtained at each of the six sites and used to determine the nature of written communication demands on the job and in the vocational training program.

Mathematics demands were determined through surveys of materials from the job sites and classrooms. Instructors and supervisors

responded to a questionnaire about the specific mathematics skills necessary for job and/or training program success.

Important non-literacy characteristics were identified by supervisors who completed a rating scale which asked for their estimate of the importance to job success of such factors as cooperativeness, reliability, and attitude toward work.

The following sections of this report are organized according to the requirements of the job, the requirements of the training program, and instructional recommendations.

PART I

REQUIREMENTS ON THE JOB

The Job Sites Studied

The literacy demands at each of three separate job sites were examined. Reading, writing, oral language and math were the specific literacy skill areas examined. The job sites were diverse, including an automotive shop employing four mechanics, one with fifteen mechanics, and a major automobile dealership service department. Each mechanic who participated in the project was identified as a successful worker by his employer.

Samples of oral language requirements were obtained by recording a randomly selected one-hour period of on-the-job verbal interaction. At each job site, the automotive mechanic's immediate supervisor completed a questionnaire which asked about the importance of eleven worker characteristics. Supervisors were also asked to identify the mathematics skills necessary for job success and to estimate the amount of time per week the workers spent using mathematics and reading skills.

Reading Demands

The amount of job time devoted to tasks requiring reading ranged

from one hour to ten hours per week. Both the time requirements and the nature of the materials at both the training program sites and job sites were very similar. In fact, many of the same books and manuals used in the training program were found on the shelves and benches of the three job sites studied. In cases where the books varied, the vocabulary, style of writing, and organization of text were very similar.

The styles of writing found in the materials at the job sites ranged from an informal conversational style to a very technical style which required knowledge of specialized terminology for understanding.

The difficulty of the required reading materials was estimated by computer analysis using the Dale-Chall Formula and the Fry Readability Graph. Because several materials were examined at each job site, and because of variation in the estimates made by the two methods, Table I presents readability levels in ranges of difficulty. A range of tenth through twelfth grade level would indicate that the materials evaluated were similar in difficulty to materials used in high school.

TABLE I

READABILITY ESTIMATES

Site One	Tenth to college level
Site Two	Ninth to twelfth grade level
Site Three	College to college graduate level

Due to the highly technical nature of the materials, instruction in vocabulary and special preparation prior to reading selections appears to be necessary, even for persons with good reading skills.

When technical vocabulary and concepts are understood, the level of difficulty of the materials is greatly reduced. Another factor which seems to reduce the difficulty of the materials is the frequency with which they are used. Thus, knowledge of important technical words and concepts and frequent repetition can offset the level of difficulty indicated by readability formulas.

Special Considerations and Problems

Similar sentence structures and organizational style were found in the studied materials. Information was often presented in a step-by-step fashion. Steps were often numbered and sentences were sometimes abbreviated by omitting non-essential function words. An example of this would be: "Connect snap-ring to shaft end. Listen for click." The word the is omitted in each sentence, yet meaning is unaffected.

Other style features that the automotive reading materials shared were frequent use of diagrams, charts and illustrations. New terms were often defined in context immediately after they were first used. Illustrations of each of these aids to comprehension are found in Examples I and II below:

EXAMPLE I

Graphic Aids

A.

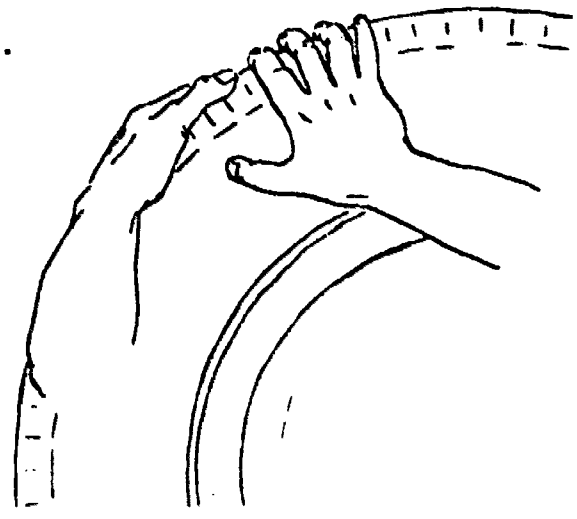


Figure 1.
Placement of Hands in Cnecking
Wheel Bearing Play.

Wheel bearing adjustment can be checked by a push-skill procedure. Place one hand at ten o'clock on the outboard side of the tire. (Fig. 1). Place the other hand on the inside. Push and pull. Note any play. Adjust as necessary.

Snug the lug nuts and tighten according to Figure 4.

B.

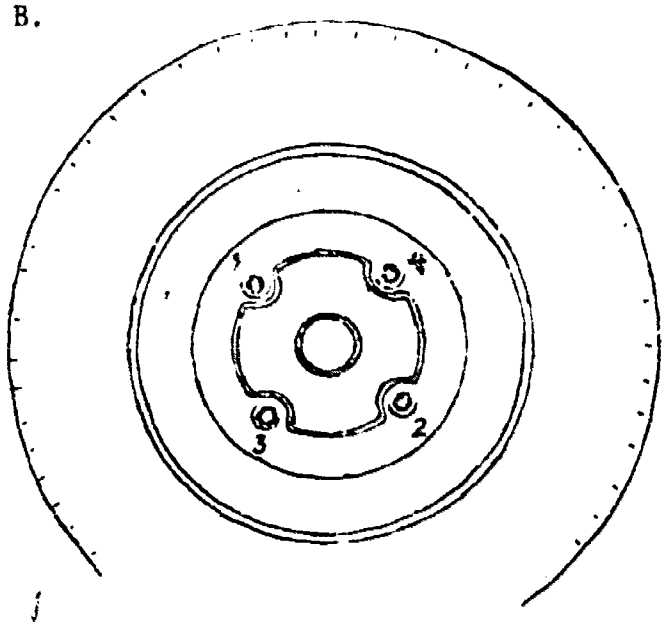


Figure 4.
Wheel Lug Tightening Sequence.

EXAMPLE II

Use of Contextual Explanation

A. "No current can flow under these conditions. Voltage applied in this way is called reverse bias, figure 3-6. If reverse bias voltage is very high, the diode will break down, and current will flow. One of the most common ways to rate a diode is in terms of its peak inverse voltage (piv). This refers to the amount of voltage a diode can withstand before it breaks down and allows reverse current flow." (Layne, Changelon, & Clark, 1978, p. 32)

B. "In other words, the handbook is a complete engineering analysis of what the ideal inspection program should consist of. And it is complete, containing over 200 pages outlining in detail what checks are to be made and whether or not the vehicle should pass or be rejected." (Crouse, 1973, p. 131)

Use of Reading on the Job

The results of the questionnaires concerning the use of reading by automotive mechanics in their work revealed that for most jobs, reading was done in order to accomplish the work at hand. That is, it was not necessary to remember what was read for more than a few hours. Mechanics indicated that it was necessary to understand what was read to follow steps exactly, but that if a given job were to be done the following day, they would read the same manual again.

Workers emphasized that the ability to interpret charts and diagrams was crucial. Interpretation of schematics and complex diagrams should probably be considered specialized automotive training subject matter. Instruction in the use of tables and specifications charts may be valuable to the ABE student interested in becoming an automotive mechanic.

Writing Requirements

Grammatically correct writing skills were not essential for automotive mechanics on the job. Most writing involved one or two word descriptions of work accomplished. Informal notes were often written in connection with a sketch or diagram. Such notes, however, were usually meant for the mechanic's own use. Legibility was not crucial, in that questions about meaning could be resolved orally with little inconvenience.

Mathematics Requirements

The mathematics skills requred on the job were virtually the same as those required in the vocational training program. Addition, subtraction, multiplication and division of whole numbers and decimal fractions, addition and subtraction of mixed fractions, and measurement concepts of length and volume were important basic mathematics skills for automotive mechanics on the job. Moreover, mechanics often use test equipment which requires the reading of scales.

It was estimated that mechanics spend an average of two hours per week on mathematics tasks. This is often done in conjunction with reading tasks.

Oral Language Requirements

The oral language samples collected on the three job sites were largely informal in nature. Conversation was casual and often not job related. However, language was heavily weighted with words such as those found in Appendix A, Key Technical Vocabulary. At these times discussions focused on the specific problem or object with which the mechanic was working. In other cases, the attention of co-workers was called to a particularly worn or malfunctioning component. Example III reflects this type of interaction.

EXAMPLE III

ORAL LANGUAGE

Mechanic I: What do you think needs work on there?

Mechanic II: It's either got a wire off the solenoid, the neutral safety switch isn't working, or the seatbelt relay box like I fixed on that one the other day is messed up.

Key Non-Literacy Requirements

Supervisory personnel rated the following traits as necessary to job success as an automotive mechanic: job knowledge, good attendance, cooperativeness, positive attitude toward work, ability to follow spoken directions, and thoroughness.

The importance of these qualities was rated higher than reading and mathematics skills by some supervisors. It seems important, therefore, to spend instructional time discussing worker qualities which are directly related to job success.

PART II

REQUIREMENTS OF THE VOCATIONAL TRAINING PROGRAM

The Courses Studied

The reading, writing, oral language and mathematics requirements of three courses in a post-secondary vocational school training program were studied. The courses, Automotive Electrical Systems, Automatic Transmission, and Service Organization, were determined by their instructors to be representative of the automotive mechanic training program as a whole. In other words, the demands placed on students in other automotive courses were about the same as those presented here.

Because each of the courses had a large laboratory component, there were many opportunities to relate written and spoken information to concrete materials and experiences. Such experiences probably lessen the literacy demands of the training program as a whole.

Reading Requirements

It was estimated by the instructors that an automotive mechanic student spends an average of three hours of reading per week in each course. Training programs typically make greater demands on literacy skills than occur at the job sites. This is because large quantities of information are presented during a relatively short period of time.

Lectures and textbooks are to a large degree substituted for the first-hand experience and one-to-one supervision which can occur on the job.

Reading materials in the form of textbooks, shop manuals, workbooks, and classroom hand-outs were rated according to the styles in which they were written. The rating scale included informal, formal, literary and technical styles. The materials surveyed were predominantly written in a technical style such as shown in Example IV.

EXAMPLE IV

Technical Writing Style

"When the upshift in D to second (second drive) takes place (is produced by the hydraulic system), the front clutch remains applied but the rear band releases and the front band applies (Fig. 11-8). When the front band applies, it locks the reverse sun gear." (Crouse, 1976, p. 147)

Table II, below, presents the levels of readability for materials used in the three automotive courses. As in Part I, estimates are reported as ranges.

TABLE II

TRAINING PROGRAM READABILITY ESTIMATES

Course One	Twelfth grade to college graduate level
Course Two	Ninth to tenth grade level
Course Three	College level

Sentence and paragraph structures found in automotive technical materials were different from prose forms found in most reading

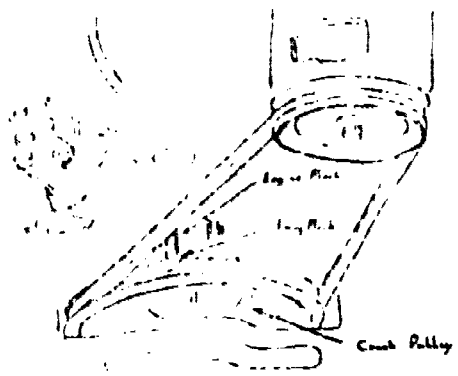
materials. The technical materials which form the automotive program emphasized following directions and interpreting graphic charts and diagrams. Often function words such as the were omitted, causing the style of writing to resemble the style found in telegraphs. An example of this would be: "Chock rear wheels, set brake, raise car." Part III of this report suggests methods of dealing with such styles of writing.

Special Considerations and Problems

The reading materials surveyed in the automotive mechanic training program relied heavily on the use of diagrams, pictures, figures, and charts which were coordinated with the written text. Written directions were presented in a step-by-step manner. These had to be understood and followed by the student. Example IV illustrates the pictoral and sequential nature of the materials.

EXAMPLE V

Sequential Instructions with Illustration



Ignition Timing

(1) Turn engine until the timing mark on the crank pulley aligns with mark on engine (Figure 2-3).

(2) Loosen distributor locknut.

(3) Turn ignition switch to "ON".

An aspect of printed materials which was commonly found in training materials was the presentation of information in the form of tables. Parts lists which included brief descriptions, part numbers, and prices, for example, were to be mastered by auto mechanic trainees.

Example VI shows a typical table used in the training materials for automotive mechanics.

EXAMPLE VI

Table Used in Automotive Shop

Labor Cost Table

Hours	Rates Per Hour			
	$4.00	$5.00	$6.00	$7.00
.25	1.00	1.25	1.50	1.75
.50	2.00	2.50	3.00	3.00
.45	3.00	3.75	4.50	5.25
1.00	4.00	5.00	6.00	7.00
1.25	5.00	6.25	7.50	8.75

Uses of Reading

In the training program classroom, reading was used primarily as a tool for learning and retaining important information. However, in the laboratory or shop phase of training, reading was often used as a tool for accomplishing a job. That is, directions were read each time the job was done. This was similar to on-the-job reading, where directions may have been read daily or at widely spaced intervals. The amount of repetition of reading-to-do jobs affected the difficulty of the reading task; familiarity tended to make the reading easier.

Reading to learn typically involved material such as that in Example VI, above. Reading-to-do materials were similar to those found in Example IV and V.

Writing Requirements

The ability to communicate important information through writing was necessary in the automotive training program, however, instructors did not demand perfect spelling, grammar, or sentence structure. Answers presented in legible, short answer (one word or phrase) form were accepted. The following is an example:

EXAMPLE VII

A Written Response

Question: "One cause of failure of an engine to start is:"

Written Answer: "Wet Distributor"

Mathematics Requirements

For each of the courses studied, the basic processes of addition, subtraction, multiplication, and division were necessary. The ability to add and subtract unlike fractions also was required. Mastery of the decimal system through ten thousandths (.009) was also necessary. In addition, during the course of their training, automotive mechanic students learned to use special measurement tools which required knowledge of linear, weight, pressure, and volume measures. Ability to solve word problems was essential. The following is a typical word problem.

EXAMPLE VIII

MATHEMATICS PROBLEM

Add ten thousandths to the piston diameter when reboring the cylinder. The original piston is 3.025" in diameter. What is the diameter of the new piston?

Instructors rated mastery of basic mathematics, including the factors noted above, as essential for future job success, although it was estimated that a student spends an average of only 5% of course time on mathematics tasks.

Oral Language Requirements

Oral language used in automotive training programs was usually informal, but much technical information and many specialized words were involved. The informal style of the instructor's language used phrasing which may have been confusing to students who were unfamiliar with it. An example of this is: "If the battery polarity is reversed: smoke!!" "Smoke" in this case means a ruined electrical system.

The requirements of the automotive classroom were typical of classrooms in general. Students had to take notes and follow directions. The heavy use of visual aids and chalkboard diagrams by instructors seemed to ease the listening burden. Automotive mechanic students were expected to jot down important information and diagrams. An excerpt from a classroom lecture requiring note taking follows.

EXAMPLE IX

CLASSROOM LANGUAGE

Instructor: (referring to a chalkboard diagram; using hand gestures)

"Let's go back to those--to what's happening inside that stator winding. We've got a rotor with magnetic poles rotating. Right? O.K., what happens when all of a sudden we've got no magnetic load. Here we were inducing some current, and now we don't have anything to induce against..."

PART III

INSTRUCTIONAL RECOMMENDATIONS

Project Overview

Reading materials for automotive mechanics were similar on the job and in the training program. As measured by readability formulas, the materials were difficult, with estimates ranging from ninth grade to college graduate levels. However, due to the high concentration of technical terms the difficulty would be lowered for trained automotive mechanics.

Reading materials often had a step-by-step style of presentation and were supported with charts and illustrations. Although usually quite technical, the materials were sometimes characterized by an informal, conversational style. Often the writing was condensed into "telegram form," omitting unimportant function words.

Mechanics on the job usually read only to accomplish work. Very little time was actually spent reading. More time was spent reading in the training program, and the students had to read to learn as well as to accomplish tasks.

Writing requirements on the job were extremely limited. More writing was required in the training program, but there was no emphasis on grammar or spelling. Although oral language both on the job

and in the training program was also informal, it demanded an extensive technical vocabulary.

Automotive mechanics on the job and in the training program were required to add, subtract, multiply and divide decimal fractions and add and subtract mixed fractions. A working knowledge of such measurement concepts as length, volume and pressure was expected. Mechanics also had to read and interpret a variety of instrument scales.

Some job supervisors rated factors such as job knowledge, attendance, cooperativeness, attitude, ability to follow directions and thoroughness higher than reading and math skills.

A brief summary of how the literacy requirements of the automotive mechanic compare to those of the other nine occupations studied is found in Appendix C.

Organization of ABE Lessons

The recommendations which follow are meant to aid teachers and tutors in designing streamlined lessons which develop literacy skills while imparting job-related knowledge. The majority of the literacy information studied in connection with automotive mechanic jobs and training programs was related to reading. Reading demands were found to be high, and when mathematics, writing, and oral language skills were used by workers and students, they were often used in conjunction with reading. This section, therefore, presents background information and a method of organizing ABE lessons which emphasizes reading. The background information provided deals with the teaching of vocabulary and teaching about text structure and organization. The lesson format is based on a directed reading activity (DRA) and includes vocabulary and concept development, sentence and organizational

structure, silent reading, and skill development.

The guiding principle of a DRA method of ABE lesson organization is that words, concepts and skills must be introduced and practiced in situations and materials that are true to life. For example, words, sentences, tables and illustrations should be similar to those used on the job or in the training program. It may be possible to teach an interested ABE student all of the words on the Key Technical Vocabulary List in isolation, but a better practice is to introduce and practice such words in contexts similar to those found in occupational reading materials. In the case of ABE lessons, there may be a wide gap between the reading requirements of occupational materials and the reading abilities of the student. If they have time, teachers and tutors can develop materials which parallel those found on the job and in the training program. By paraphrasing sections of textbooks, reference books and manuals, the readability of occupational materials can be reduced so that literacy skills and job-related knowledge can be developed simultaneously.

The value of a DRA approach is that it allows the use of any appropriate reading material in a job-related reading skill development program.

Notes on Teaching Vocabulary

Much of the vocabulary used in vocational courses is highly technical. The automotive systems important to the work described in this report have specialized vocabularies which must be mastered. However, a survey of the Key Technical Vocabulary List (Appendix A) shows that many of the words used most commonly in automotive mechanics are common to English in general.

Specialized technical vocabulary words must be taught for recognition and meaning. Two types of words present problems to the ABE student and, to a lesser extent, the beginning student of automotive mechanics. The first type of word is unique to the trade; "panhard rod", a suspension component, is a term used in automotive mechanics alone.

The second type of problem word is one which has a common meaning in everyday communication, but which also has a specialized technical meaning. For example, the meaning of "branch" in everyday usage means part of a tree. This meaning in common usage is only vaguely related to its meaning in electrical circuits where it refers to a path through which current may flow from a main circuit.

It is important for the ABE student to be introduced to both types of words in a context similar to that in which they will be used in automotive courses. Whenever possible, concrete objects or illustrations should be used during instruction.

Teaching suggestions for vocabulary development include the following:

1. Pair the word to be taught with the object or concept that it refers to.

2. Introduce the word using an approach which focuses student attention on the words.

3. Be sure that the new word is read in context soon after it has been taught.

4. Use the rule of thumb that four to six new words are taught during one lesson.

5. Review words frequently.

Sources of lessons for vocabulary and automotive concepts can be found in bookstore manuals by Clymer, Chilton, Peterson, Haynes, and other publishers. The style of writing in such manuals varies greatly, and teacher time could be planned for preparing written materials which parallel passages in the manuals. It is important, however, to expose students to the style of the materials they must eventually work with.

Notes on Teaching About the Structure and Organization of Text

The above vocabulary suggestions emphasize meaning. Words have little use out of context. It is important, therefore, to spend time teaching ABE students how to deal with unusual sentence structures and paragraph and textbook patterns of organization. This means that prior to each lesson the teacher should preview the material to be studied and identify unusual sentences and organization as well as vocabulary.

Directed Reading Activity

After a review of previously taught, related concepts and assignments·

I. Develop Readiness for Reading the Assignment.

Purpose: Motivate
Set purposes for reading
Develop vocabulary

Teacher role: Ask Questions -

How familiar is the subject matter and vocabulary to your student?

Teach New Vocabulary -

Be concrete: write out the words as you introduce them. Use examples, such as objects or pictures, point out word relationships; i.e., cardiograph and cardiovascular relate to cardiac - heart. Have students write the words as they are taught.

Ask Questions to Stimulate Interest -

Focus on titles, pictures, graphs. Relate an anecdote from your own experience or one your students might have had.

II. Direct the Silent Reading of the Assignment.

Develop questions from sub-headings, graphs, pictures, and tables. Try to focus on relationships in the assignment. In textbooks useful questions are often provided by the authors.

Have pupils read silently from 5 to 20 minutes to find the answers (keeping questions in mind as they read).

Encourage students to ask for help when they are confused. Writing questions down in shorthand form is a good practice when reading is done outside of class.

III. Discuss Student Answers to Questions.

Do not restate the questions unless necessary. Students need to remember the questions or they lose the purpose for reading.

Ask higher level questions to develop comprehension (have student(s) interpret, draw conclusions, and make inferences as well as recall facts).

IV. Reread as Necessary.

When answers demonstrate confusion, have the student reread the appropriate small section to determine the reason for the confusion.

V. Follow-up and Skill Development

Confusion or lack of comprehension may signal a need for extra work on vocabulary, concept building or word recognition skill.

In this phrase of the lesson important mathematics and other skills can be related concretely to the reading assignment.

REMEMBER:

A DRA is a system, a routine, that you want your student(s) to learn to use independently. Remind your students of this - tell them why you use a DRA system. It will help them now and in their future study.

Reading to Accomplish Work

The phrase reading to do has been used in research and development projects done for the U.S. armed forces (Sticht, et al., 1977). Reading to do refers to the use of reading for the purpose of getting work done. It involves following written directions and reading to find information which will be used immediately. Such information need not be learned or remembered. Looking up telephone numbers, finding information in a policy manual, or finding important data in a table, chart or figure are examples of reading to do. Preparation of ABE students for reading-to-do tasks can be incorporated in a directed reading activity lesson.

When lesson materials contain occupationally relevant concepts, ABE students are given important background information which will make higher level training easier. Therefore, lessons should employ materials which are similar in structure and content to those found on the job or in the vocational training program. Paragraphs, tables,

charts and figures might be used verbatim from on-the-job or instructional materials. Alternatively, when possible, such materials might be paraphrased and reduced in difficulty to match student abilities.

Given appropriate materials and a period of orientation to them, the structrual and organizational features of the table, chart, figure, paragraph or chapter should be pointed cut to the student (see Notes on Teaching About Structure and Organization of Text). This is essentially the first step of the DRA described above. When the materials have been introduced, the student should be directed to find a particular fact in the material. (In subsequent lessons, the difficulty of information-finding tasks should be increased).

Skill in following written directions can be developed using a DRA system and materials similar to Example IX. Initial activities should contain only one or two steps to follow.

EXAMPLE IX

Written Directions

Valve Housing

> If the valve housing has a relief valve fitted, remove it with a 1" wrench.
>
> From the relief valve, remove the two "O" rings and the seal ring. The seal ring will have to be cut off.
>
> Loosen the poppet valve adjusting screw locknut and back off the adjusting screw approximately two turns. (TRW Inc., Ross Gear Division, 1977, p. 3).

In information-finding lessons, the emphasis should be on understanding and careful identification of the required fact. Likewise, in lessons on following directions, understanding and careful execution of the required steps must be emphasized.

Reading to Learn Information

Skill in learning printed information for future use is very important in vocational training programs. The reading skills necessary for reading to learn (Sticht, et al., 1977) are taught and systematically practiced in directed reading activity lessons. That is, the use of previewing, attention to graphic and contextual information and organizational factors should be practiced and learned during each DRA lesson. Questioning and rereading, alsc aspects of the DRA, reinforce important learning skills.

Sources of materials for use in reading-to-learn lessons, like those employed in reading-to-do lessons, should be occupationally oriented (see Bibliography). ABE students who receive reading instruction through job-related reading materials develop not only reading skills, but gain important job knowledge as well.

Counseling the ABE Student

ABE students should be made aware of the importance of reliability, cooperation, ability to follow directions, and other factors noted in Part I of this report. On the basis of the responses of supervisors surveyed in this study and previous research (Sticht, 1974), it seems that such characteristics may contribute more to job success than do reading and mathematics skills. Role-play activities which involve consideration for others and following directions may be a valuable part of ABE lessons designed to prepare adults for employment.

The literacy demands of the automotive mechanic jobs and, specifically, training program courses were reasonably high. It is,

therefore, important that teachers, tutors, and counselors consider the facts presented earlier in this report, the individual students' levels of motivation, and literacy skill development before beginning to prepare the student to enter an automotive mechanic job or vocational training program. Frequency and intensity of lessons, choice of instructional materials, and long-term duration of the instructional program will vary according to the student's literacy skill level, especially in reading.

This does not mean that students with low literacy skills should be discouraged from preparing for an automotive mechanic career. It does suggest, however, that an early and realistic estimate be made of the time and effort required to reach the goal of employment or formal training.

Summary

The literacy demands of automotive mechanic jobs and training program courses were found to be high. It is probable that individual experience and familiarity with specialized information reduces the perceived demands of job and training program tasks. The extent of such a reduction, however, is not known.

It was observed that the vocational training program for automotive mechanics provided students with experiences that were similar to on-the-job tasks. Reading materials from the training program presented important basic occupational concepts through texts which were similar in style and difficulty to materials found at the job sites. Research supports the practice of reducing readability levels when difficult concepts are presented in written form. However, training program instructors reduced the effect of difficult reading

materials by paralleling textbook assignments with laboratory sessions and lectures.

Instructional recommendations emphasized the development of reading skills. Other literacy and non-literacy requirements were recognized as important, but it was clear, even in cases where mathematics skills were necessary, that good reading skills were important.

The recommended approach to ABE reading instruction was a directed reading activity (DRA), because it is systematic, provides for essential skill development and practice, and permits the use of any appropriate reading material. Suggestions were presented for teaching vocabulary and on the use of important structural and organizational factors which are related to reading comprehension and memory.

Two uses of reading, reading to do and reading to learn, were discussed separately because the skills they require are distinct. Reading to do requires the ability to find information for immediate use; long-term memory is not necessary. Reading to learn requires awareness of organizational factors which aid learning and remembering.

Non-literacy factors were discussed in the section, Counseling the ABE Student, because on-the-job supervisors rated several factors such as attendance and cooperativeness to be as important to job success as reading and mathematics ability.

Finally, it was recommended that in using the information and recommendations presented in the report ABE teachers should be well acquainted with the occupational interest and motivation as well as the literacy skills of their students. The literacy demands of

automotive mechanics, on the jobs and in training program courses, are such that some students may be unable to achieve sufficient skills within a reasonable period of time. Such students should be encouraged to change their occupational goals.

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Philadelphia, Pennsylvania 19106

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Los Angeles, California 90004

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9421 Winnetka Avenue
Chatsworth, California 91311

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APPENDIX A

TECHNICAL VOCABULARY LIST

This list is based on the total oral and written samples of the language of automotive mechanics both on the job and in the training program. Words included in the most frequent 1000 words of the Kucera-Francis list (based on adult language) have been deleted. The list was also edited to remove numerals; labels; names of people, places, products, and companies; contractions and possessives; and colloquialisms resulting from the oral language samples.

Some words included in the list are relatively uncommon words that occurred in the total language sample and are not necessarily technical terms. Thus, the list should be treated as a source rather than a criterion. The 83 most common words have been marked with an asterisk.

Total Sample Words = 20,900

Different Words = 3,03

absence	additives	aligns	applicable	attach
absolute	address	alleged	applicant	attached
absorbed	adds	allow	applicants	attaches
absorber	adequate	allowable	application*	attaching
absorbers	adjacent	allowing	applied	attacks
abusing	adjust*	allows	applies	attempt
accelerate	adjusted	alternating	apply	attempting
acceleration	adjuster	alternator*	applying	attendant
accelerator	adjusting*	aluminum	appreciable	attract
acceptable	adjustment*	amazing	approaches	attracted
access	admitting	ammeter	approval	authorized
accessories	adult	amounts	approved	auto
accident	advance	amp	approximate	automatic*
accidents	advise	amperage	arm	automobile
accompanies	adviser	amperages	armature	automotive
accomplish	advising	amperes	arrange	avoid
accumulator	affect	amps	arranged	axle*
accurately	affixed	anchor	arrangement	backed
acid	afford	angle	arrived	backing
actions	afraid	announcement	aside	backs
active	agent	answering	asking	backward
acts	agents	answers	assemble	backyard
actuators	aggrieved	antifreeze	assembled	bag
adapted	airflow	anyway	assemblies	ballast
adapters	align	apart	assembling	band
add	aligned	appears	assembly*	bands
adding	alignment	appliance	assumes	bang

bar
basically
bat
batteries
battery*
bay
bearing*
bearings*
beat
becomes
begin
beginners
begins
believes
bell
bellhousing
belonging
belt
belts
bench
bending
bendix
besides
bevel
beware
bezel
bezels

bias
bicycle
biggest
bind
binding
bit
bite
blades
blank
blister
block
blocking
blow
blowing
blueprint
bodies
bolt*
bolted
bolts
booklet
books
boot
booth
bore
bottom
bought
bowl

box
bracket
brake*
brakes
braking
branch
branches
brass
breaker*
breakers
breathe
brief
brighter
broken
brush*
brushes
bubble
buck
bucks
buffer
build
buildup
built
bulb
bulk
bureau
burn

burned
burning
burnishing
burred
bushing
bushings
busy
butt
button
buy
bypass
cable
cables
calculated
calling
calls
camshaft
canned
cap
carburetor
careful
carefully
carpet
carrier*
carriers
carry
cash

casing
catch
caught
caused
causes
causing
caution
centerpunch
centrifugal
certification*
certified
chain
chances
changing
chapter
chapters
charged
charger
charging
chart
chassis
cheap
check
checked
checking
checks
chemical

chipped
choke
circle
circuit*
circuitry
circuits
circulate
circumstance
clamp
clamping
claws
clean
cleaned
cleaning
clearance
clevis
clip
clips
closed
closes
cloth
cloths
cluster*
clutch*
clutches
coast
coasting
coat
cocked
coefficient
coil*
coils
collapses
collect
colors
column*
columns
combines
combustion
commander
commission
commonly
commutator
compare
compared
comparison
compartment
compensate
complaint
complaints
completed
completing
completion
complicate
component*
components
composition
compressed
compresses
compressing
compression
compressor
concisely
condensation
condenser
condition
conditioning
conducted
conductor
conductors
conduit
cone
confuses
confusion
conical
conjunction
connect
connected
connecting
connection
connector*
connectors
considering
consist
consists
console
constant
constantly
constitute
construction
consult
consulting
contact
contactor
contacts
containing
contains
contingency
continually
continuation
continues
continuity
contractor
controlled
controls
convenient
convention
convert
converter*
converters
coolant
cooler
coolers
cooling
cooperation
coordinate
copper
copy
core
corporation
correct*
corrected
correcting
correctly
correspond
corroded
corrosion
cotton
counterclockwise
countershaft
counting
couples
coupling
courteous

cover*	damage	demand	diagram	dispensing*
covered	damaged	demonstrated	dial	display
covers	damping	dented	diameter	disposal
cowl	dart	dents	diaphragm	disposed
cracks	dash	depending	differentiate	distort
cranked	date	depreciating	difficulty	distortion
cranking	dealer	depress	dim	distribute
crankshaft	dealing	depressed	dings	distributor
created	deals	depressing	diode*	divide
critical	decade	depth	diodes*	divided
cross	deceleration	describe*	dip	dividing
cruise	decreases	describing	dipstick	document
crunch	decreasing	description	directing	dollar
crushed	deduct	designated	directs	dollars*
cup	deductible	destroy	dirt	domestic
cupboards	defective	destroyed	dirty	domestically
cure	defined	detach	disassemble*	doors
current*	defines	detail	disc	doped
curved	definite	details	discharge	double
cushion	definitely	deteriorate	disconnect*	downs
cushioning	deflection	determines	discs	downshift
customer*	deflector	device	discussed	downward
customers	delay	devices	discussing	dozen
customizing	delicate	diagnose	disengaged	drag
cycling	deliver	diagnosed	disk	dragging
cylinder	delivered	diagnosis*	dispatcher	drain
cylinders	delivers	diagnostic	dispense	drained

draining	easily	energy	exact	exterior
draw	economy	engage*	exactly	external
drawing	edge	engaged	examination	externally
draws	efficiency	engagement	examine	extra
dressed	efficient	engages	exceed	extreme
drift	efficiently	engine*	exceeding	eyebolt
drill	eight	engineering	exception	facilitate
drip	elaborate	engines	excess	facilities
drive*	elbow	ensure	excessive	facing
driven*	electric	ensures	excessively	facings
driver	electrical	enter	exchangers	factors
drivers	electrolyte	entry	executive	factory
drives	electromagnet	equal	exempt	fail
driveshaft	electronic	equally	exerted	fails
driving*	electrons	equip	exerting	failure
drop	elemental	equipped	exhaust	fairly
dropped	eliminate	equivalent	existing	familiar
drops	eliminated	essentially	expanding	fan
drum	elite	estimate	expensive	farther
dry	elsewhere	estimates	expire	fast
duct	emerges	estimating	explain	fastened
dust	emission	etc.	explained	faster
dustfree	empty	event	exposed	fatal
dynamic	enables	events	extended	faulty
earliest	ends	eventually	extending	fee
easier	energized	everybody	extends	fees
easiest	energizes	everyday	extension	fenders

fields	float	forwarded	garden	grease
fifteen	floating	fours	gas	greatly
fifty	floorboard	fraction	gases	grect
fig.*	flow	frame	gasket	greeted
figuring	flows*	freely	gasoline	grew
file	fluid*	freewheel	gassing	grind
filed	fluids	freewheeling	gauge	gripping
fill	flush	freezing	gear*	groove
filled	flushed	frequency	gearing	grooves
film	flushes	fresh	gears*	gross
filter	flushing	friction	gearset	grounded
findings	flux	frontwheel	generalities	groundwire
finger	fly	fuel	generates	grouped
finished	flywheel	fuels	gentlemen	guess
firewall	fog	fully*	gets	guesswork
firing	follow	functioning	giving	guide
firmly	follows	functions	glance	guy
fit	followup	furnished	glasses	guys
fits	foot	fuse	glimpses	halfway
fitted	foreman	fused	goes	hamper
fixed	forget	fuses	gouges	handbook
fixture	forgets	fusible	governor	handle
flange	fork*	gain	grabbing	handles
flat	forked	gained	grand	handy
flats	formed	galling	grapevine	hang
flies	forth	gallons	gravity	happen
flip	forty	gap	gray	happening

happens
harden
harder
harmful
harness
harnesses
hatchback
hazard
heading
hearing
heat
heater
heavier
heavyduty
height
helical
herein
hesitant
highways
hog
hoist
holder
holding
holds
hole
holes
hood
hoods
hook
hooked
horn
horseshoe
hose*
hoses
housing*
hub
hurt
hydraulic
hydrogen
hydrometer
ideal
identical
identification*
identified
identify
identifying
idler
ignition*
ignitions
illuminate
illustrate
illustration
imagine
immediately
immerse
impeller
implementing
imported
impossibility
improper
improved
inability
inch
inches
includes
incoming
incomplete
incorporate
incorrect
increasing
independent
index
indicate
indicates
indicating
indication
indicator*
induced
induction
inductive
initiate
injure
inline
inner
inoperative
input
insecticide
insert
inserted
inserting
insofar
inspect
inspected
inspection*
inspector
inspectors
install*
installation*
installed
installing
instruct
instruction
instrument
insulate
insulating
insulation
insulator
insurance
intake
integral
intended
interchange
intercom
intermediate
intermixable
internal
intervals
intricate
introduced
introduction
invalid
inventory
investigation
investment
invisible
involves
isolate
isolation
issued
items
jam
jamb
jammed
jet
jobs

join
joints
joy
joys
jumper
junction
junk
keeps
kerosene
key
keys
kick
kill
kilometers
kinds
kit
kits
knob
knobs
knocked
knocking
knows
lab
lacks
lamp
latch
latches
lathe
laugh
launching
lawn
lbs.
leading
leads
leakage
leaking
leaks
learn
leaves
leaving
lengths
lets
letting
lever*
leverage
levers
license*
licensed
licensee
licensing
lift
lightening
lightly
lights
lightweight
likewise
limited
link
linkage
links
lint
listed
lists
load
loaded
loads
locate
located
locating
location
locations
lock
locked
locknut
locks
lockup
looks
loose
loosen*
loosened
loosening
lose
loses
loss
lots
loud
lowered
lowering
lowers
lowest
lubricant
lubricants
lubricate
lubricated
lubricating
lubrication
lug
lugging
lugs
lunch
machine
magazine
magnet
magnetic
magnets
mainshaft
maintain
maintained
maintaining
maintenance
maker
manager
manifold
manual*
manually
manuals
manufacture
mark
marked
markings
marks
master
match
materially
materials
mathematics
matters
maximum
meaningful
measure
measured
measurement
measuring
mechanic
mechanical

mechanics	mode	names	nuts	option
mechanism	model	nationally	nylon	optional
mechanisms	models	neatly	obtaining	orange
melt	modes	necessarily	occur	orders
melted	modification	needing	occurred	ordinarily
melts	modified	needle	occurs	ordinary
mesh	modular	needles	odometer	
meshed	modulator	negative	offer	origin
mess	module	neighborhood	offers	original
messed	modules	nervous	officer	originally
metal	moistened	neutral	officers	otherwise
meter	molded	nice	official	outer
mile	molecules	nine	ohmmeter	outlining
mileage	morane	ninety	oil*	output*
mine	motion	noise	oils	overdrive
minor	motor*	noises	older	overfilling
minute	motorcraft	noisy	opening	overhaul
miracle	motors	normally	openings	overhauls
miracles	mount	notch	operate	overrevving
mirror	mounted	notebook	operated	override
mirrors	mounting	notice	operates	overrunning
misadjusted	mouth	noticed	operating*	owing
missing	movable	notification	operations	owner*
mix	moves	notifying	operator	owners
mixed	muffler	noting	opinion	oxygen
mixes	multiplication	nozzle	opposing	pad
mm	mutilation	nut*	opposite	page

pages	permit	plate*	preferable	produce
pain	permits	plates*	preinspect	produced
paint	permitting	pleasant	preliminary	produces
painting	petition	pliers	preload*	product
paints	petitioner	plug	preloaded	profitable
pair	phrase	plugs	preparation	profitsharing
pairs	phrases	plunger	prepare	project
pan	pick	pockets	prepared	prompt
panel*	picker	pointer	presented	promptly
pants	pieces	polarity	presized	proper
parabolic	pin*	polish	pressed	properly*
paragraphs	pinion*	polished	presses	protect
parallel	pinions	portion	pressing	protective
park	pink	positioned	pressures	protects
parked	pinned	positioning	pretty	protrudes
parking	pins	positions	prevent	protruding
pass	pipes	positive	previously	provides
passage	piston	positively	primary*	providing
passages	pistons	possession	principles	pry
passes	pitch	possibility	printed*	psi
path	pitched	possibly	prior	publish
patterns	pivot	post	prix	published
payroll	places	pound	probe	pull*
pedal*	placing	pounds	probes	pulled
perform	planet	pour	procedure*	pulley
periodical	planetary	powered	procedures	pulling
permanent	plastic	preceding	proceed	pulse

pump*	rag	receives	reinforcement	repair*
pumped	raise	recommend	reinspected	repairing
pumper	rapidly	recommendation	reinstall	repairs
pumps	rated	recommending	reinstallation	repeat
punch	ratings	recommends	reinstalled	repeated
purchase	ratio	reconnect	reinstalling	repel
purchaser	ratios	reconnected	rejected	replace*
purposely	rattles	recorder	related	replaced
pursuant	rattling	rectifier	relay*	replacement
push	reach	recurrence	release*	replacing
pushes	reaches	redone	released	reportable
pushing	react	reduce	releasing	reposition
pushrod*	reacts	reduces	remain	representation
puts	readily	reducing	remainder	reprogramming
putting	readiness	reduction	remaining	request
quadrant	readjust	reface	remains	requesting
qualified	reaming	refer	reminder	requests
qualify	rear	refinement	remote	require
qualities	rearward	reform	remotely	requirement
quarter	reasonable	refund	removal*	requires
quick	reasonably	regard	remove*	requiring
quicker	reasons	regardless	removed*	reread
quickly	reassemble	registered	removing	resembles
quiet	reassembly	registration	render	reservices
quote	rebuilt	regular	renew	reservoir
race	receipt*	regulator	rent	reside
racing	receive	regulators	repainting	residence

resident
resin
resist
resistance*
resistor
resoldering
response
responsible
resting
rests
resulting
retained
retainer
retaining
retard
returns
reverse*
review
reviewed
rheostat
ridge
riding
rigor
rim
ring*
rings
rivet
rod
roll
roller
rollers
rotate
rotates
rotating
rotor
rotors
round
row
rpm
rubber
rubble
ruin
rule
rules
rumble
runner
runout
runs
sacrificing
safety
sale
salesman
salesmanship
salesroom
sample
satisfied
save
scale
schematic
scientific
score
screw
screwdriver
screws*
seal
seat*
seatbelt
seated
seats
secondary*
secret
secrets
sections
secure
secured
securely
securing
seeing
sees
seizing
select
selecting
selective
selector*
self
sell
send
sending
sentence
sentences
separate
separately
sequence
seriously
serve
serves
serviced
servicing
servo*
servos
setscrew
setting
settle
seventeen
severe
shaft*
shafts
sheet
shelves
shield
shields
shift*
shifted
shifter
shifting
shifts
shirt
shock*
shooting
shop*
shops
shorted
shorten
shoulder
showing
shows
shunt
shut
sideplay
sides
sign
signed
simplicity
simplify
simultaneously

sir	smooth	specifically	station*	stud
sits	smoothly	specification	stationary	studies
sixty	snap	specifics	stations	stuff
sizes	snappy	speed*	stator	stupid
skate	snow	speedometer	steady	subdivision
skills	snugly	speeds	steam	submitted
sky	soaked	spillage	steel	success
slack	socket	spilled	steering*	successful
slammed	sockets	spinning	stem	sufficient
sleep	sold	spiral	sticker	suggest
sleeve	solder	splined	stirring	suitable
slid	soldering	splines	stops	sulfuric
slide	solenoid*	split	storage	sum
slightest	solenoids	spoke	storeroom	superceded
slightly	solid	springs	straighten	superintend*
slip	solution	sprocket	straightened	supplied
slippage	solvent	sprockets	strand	supply
slippery	somehow	spun	strap	suppose
slipring	someone	squeezed	strictly	supposed
slot	somewhere	squirting	strip	suppression
slots	sounding	stages	stroke	surfaces
slotted	source	stainless	strokes	surges
slower	sources	stamped	strongly	surprised
slows	spaced	stands	struck	suspect
sludge	spacer	starter*	strut	suspension
smaller	sparingly	starting	struts	swelled
smallest	spark*	starts	stuck	switch*

switching
symbols
symptom
symptoms
synchronize
tab
tabbed
tabs
tackle
tail
tailored
takes
talked
talking
tangs
tank
tap
tape
tea
teardown
technician
technology
teeth*
tend
tendancy
tension*
term
terminal*
terminals
tested
tester
testing
tests
thank
thanks
thereof
thick
thickness
thicknesses
thin
thinks
thinner
thirty
thorough
thoroughly
thousand
threaded
threads
throttle*
throw
thrust*
thumbs
ticket
tighten
tightens
tightly
till
tilt
tilted
timely
timing
tip
tips
tire
title
toe
tool*
tools
toploader
torn
torque*
touch
touched
touching
tougher
towards
tower
towing
trace
traces
track
trailer
train
trains
transaxle*
transfer
transferred
transforms
transistor
transmission
transmits
travel
treat
treated
trend
trick
triggering
trim
troubles
truck
trunks
tuneup
turbine
turbo
turning
turns
twelve
twenty
twisted
twisting
twitch
typical
unavailable
unbolted
uncovering
undergoing
undergone
underneath
unhook
uniform
unique
unit*
unitized
units
unknown
unlawful
unless
unlike
unlimited
unsolder
updated
upper
upright
upshift
urge

uses
utmost
vacuum*
valid
validity
valve*
valves
vanes
variable
vary
varying
vaseline
vehicle*
vehicles
venerable
version
vertical
vibration
viewed
virtue
viscosity
vise
volt
voltage*
wagons
wait
wander
wants
ward
wards
warn
warner
warning
warped
warranty
wash
washed
washer*
washers
watch
waved
wax
weak
weakened
wear*
wearing
wears
weighed
wet
wheel
wheels
whenever
whereas
wherever
whoever
wiggles
winding
windings
windshield
wipe
wiped
wiper*
wire*
wires*
wiring
wise
withdraw
withdrawn
withstand
wonder
wondering
wonders
workbench
workshop
worn
wornout
worry
worth
wrap
wrench
write
yellow
yoke
yours
yourself
zero
zinc

APPENDIX B

HIGHEST FREQUENCY WORD LIST

The 100 words on the following page represented 45% of the words used in all the language sampled. This list is based on the combined oral and written language samples from all occupations studied. It shows the words used most frequently by adults in the ten jobs studied and in the vocational training programs corresponding to those jobs.

Total Words	=	180,000
Total Different Words	=	9,000

the	will	your	see
of	one	was	more
to	not	get	these
and	an	has	into
a	there	must	just
is	can	any	them
in	when	he	down
it	out	got	time
for	we	know	about
that	which	then	been
you	what	don't	some
be	do	each	business
or	up	air	how
on	pressure	check	its
are	two	that's	back
I	so	but	over
this	they	system	work
with	here	through	would
as	other	valve	temperature
by	ok	going	same
if	right	well	also
have	no	use	where
all	used	than	now
at	may	it's	only
from	should	go	like

APPENDIX C

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

This appendix presents a brief summary of the literacy requirements for all ten occupations studied.

SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

	On The Job		Training Program	
	Reading	Mathematics	Reading	Mathematics
Account Clerk	College to college graduate level	addition, subtraction, multiplication, division, decimals, fractions, business machines	11th grade to college graduate	addition, subtraction, multiplication, division, fractions, decimals. algebra
Automotive Mechanic	9th to college graduate level	basic processes, decimals, fractions, measurement	9th to college graduate level	basic processes, decimals, fractions, measurement
Draftsman	10th grade to college graduate	basic processes, through geometry, algebra, trigonometry	9th grade to college level	basic processes, through geometry, algebra, trigonometry
Electrician	college to college graduate level	basic processes, throguh geometry, algebra, trigonometry	10th grade to college graduate level	basic processes, through geometry, algebra, trigonometry
Heating and Air conditioning Mechanic	10th grade to college graduate level	basic processes, decimals, fractions, measurement, algebra	11th grade to college graduate level	basic processes, fractions, decimals, measurement
Industrial Maintenance Mechanic	10th grade to college graduate level	basic processes through trigonometry	10th grade to college graduate level	basic processes, decimals, fractions, measurement
Licensed Practical Nurse	10th grade to college level	addition, and subtraction--more necessary to dispense medication	12th grade to college graduate level	addition and subtraction
Machine Tool Operator	9th to college graduate	basic processes, decimals, measurement	9th grade to college level	basic processes, decimals, measurement
Secretary	College to college graduate level	basic processes, decimals, fractions, business machines	10th grade to college level	basic processes, decimals, business machines
Welder	few materials--reading of single word information required	basic processes, fractions, decimals, measurement	8th grade to college graduate level	basic processes, fractions, decimals, measurement, algebra